**Investigation 4 | Unit Enhancement**

***ENGINEERING DESIGN***

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**Background Information**

**Instructional Materials Title: Levers and Pulleys**

**Publication Date: 2005**

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**Date Developed: Aug 23, 2013**

**High Leverage Lesson (Title and Page Number): Investigation 4**

**Rationale**

**Require students to apply knowledge of simple machines to solve a engineering problem on the school site. This will vary depending on surroundings of each school.**

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**- Connections to NGSS and WA Science Standards**

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***Engineering* Lesson Enhancement**

**Overview**

· **Replaces Investigation 4**

· **Key instructional strategies and tools needed**

**Part 1: Lesson Modifications to Lead Up to *Engineering Task***

**This activity replaces Investigation 4 in the Levers and Pulleys Kit**

**Part 2: *Engineering* Learning Sequence**

1. When reading Simple Machines, emphasize simple machines in the student’s world. Include cranes in the discussion. Have students identify these machines, discuss cranes as levers and pulleys. This is an ongoing teaching/talking point.
2. Consider showing youtube video on Crane Disasters. <http://www.youtube.com/watch?v=cz22Wty5Rks> NOTE: vocabulary is inappropriate in sixth grade classroom. TURN SOUND OFF!

**Part 3-A: Engineering Task**

*Problem: identify criterion and limitations, initial student choice of design. Reevaluate design, report out.*

1. Teacher: present problem – need to create hole for swimming pool. Boulder in the location chosen – need to move boulder. Consider place to put boulder, connect to student experience. Idea: eighth graders can paint the rock in the fall for their representation as the “top class.”
2. In-class discussion: students come up with all the criterion (in discussion with teacher):
   1. Weight of boulder (collect data from Geology, previous construction, google.)
   2. Where to put the boulder
   3. Hurdles/obstacles on the way
3. In-class discussion: constraints
   1. How much money do we want to spend?
   2. Lever: student “muscle power”
   3. Material availability
   4. Can’t cut down the tree
   5. Access to location of pool/tree/buildings
   6. Access to bus routes, fire lanes and hydrants, entrance to school property
   7. Local laws, zoning and permit issues
4. In-class discussion: brainstorm solution concepts, discuss pros and cons (briefly)
   1. Levers – length of lever, material for lever, fulcrum,
   2. Pulleys – number of pulleys, length of rope, type of rope
   3. Cranes – more expensive – a and b are cheaper, time to get a crane (current Seattle – 7 yr wait to get local cranes, imported more expensive), number of cranes allowed in an area can be limited, number of people in area can be limited, traffic concerns
5. Individual write up: choice of a solution, write-up of rationale (how the design meets criteria and constraints), include labeled drawing of solution. There is a rubric for this. Students evaluate their work. If time, they can rewrite
6. In class discussion of different solutions. (possible discussion points)
   1. Lever: how to get boulder out of the hole – solution: build a ramp as we dig. What material? Soil? Slope?
   2. Pulleys: need something to hang it on: Solution: rig a support, Range is limited: increase range, Solution: use a truck below, how truck gets in/out, material to support truck
   3. Cranes: Discuss similarity to levers and pulleys, different kinds of cranes, what is the range of the crane, cost – buy/rent
7. Individual write up: reassess previous design (changes?), propose final design, rationale (how design meets criteria and constraints) for final design choice, needs to include labeled drawings. Product could be poster, large white board, oral/picture presentation.
8. Possible class presentations/discussion (time dependent, teacher choice)

**Part 3-B: Assessment Rubric - Attached**

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**Additional Information**

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* Save samples to bring to second release day